# PRODUCTION OF HIGH STRENGTH GALVANNEALED STEEL SHEET EXCELLENT IN RESISTANCE TO SECONDARY WORKING BRITTLENESS


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**Inventor:** OKUDA KANEHARU; SETO KAZUHIRO, SAKATA TAKASHI, KATO TOSHIYUKI

**Applicant:** KAWASAKI STEEL CO



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Abstract of **JP7268584**

PURPOSE:To produce a high strength galvannealed steel sheet excellent in resistance to secondary working brittleness by using an ultralow carbon steel to which Ti, Nb, and B are combinedly added. CONSTITUTION:A slab of steel, having a composition containing 0.001-0.007% C, 0.05-0.5% Si, 0.5-2.0% Mn, <=0.6% Ni, 0.01-0.2% Ti, 0.001-0.1% Nb, 0.0002-0.005% B, <=1.0% Cu, 0.03-0.12% P, and <=0.1% sol.Al, is used as a stock. This steel slab is hot-rolled and cold-rolled. After primary continuous annealing, the resulting steel sheet is pickled or brushed and then pickled. This steel sheet is subjected to secondary annealing in the temp. region where the temp. T( deg.C) is >=500 deg.C and satisfies inequality I or inequality II in which P content is represented by (%P). Successively, hot dip galvanizing and alloying treatment are executed. Further, in the steel composition, the contents of S and N are regulated to <=0.02% and <=0.005%, respectively.

$$T\ (℃) \leq 700(℃) - [\ (\%P) - 0.03\ ] \times 1000\ (℃) \qquad \text{I}$$

$$T\ (℃) \geq 700(℃) + [\ (\%P) - 0.03\ ] \times 1000\ (℃) \qquad \text{II}$$

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(71)Applicant : **KAWASAKI STEEL CORP**
(72)Inventor : **OKUDA KANEHARU**
**SETO KAZUHIRO**
**SAKATA TAKASHI**
**KATO TOSHIYUKI**

(54) **PRODUCTION OF HIGH STRENGTH GALVANNEALED STEEL SHEET EXCELLENT IN RESISTANCE TO SECONDARY WORKING BRITTLENESS**

(57)Abstract:
PURPOSE: To produce a high strength galvannealed steel sheet excellent in resistance to secondary working brittleness by using an ultralow carbon steel to which Ti, Nb, and B are combinedly added.
CONSTITUTION: A slab of steel, having a composition containing 0.001-0.007% C, 0.05-0.5% Si, 0.5-2.0% Mn, ≤0.8% Ni, 0.01-0.2% Ti, 0.001-0.1% Nb, 0.0002-0.005% B, ≤1.0% Cu, 0.03-0.12% P, and ≤0.1% sol.Al, is used as a stock. This steel slab is hot-rolled and cold-rolled. After primary continuous annealing, the resulting steel sheet is pickled or brushed and then pickled. This steel sheet is subjected to secondary annealing in the temp. region where the temp. T(°C) is ≥500°C and satisfies inequality I or inequality II in which P content is represented by (%P). Successively, hot dip galvanizing and alloying treatment are executed. Further, in the steel

T (℃) ≦700(℃) − [ (%P) −0.03 ] ×1000 (℃) I

T (℃) ≧700(℃) + [ (%P) −0.03 ] ×1000 (℃) II

composition, the contents of S and N are regulated to ≤0.02% and ≤0.005%, respectively.

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* NOTICES *



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CLAIMS

[Claim(s)]
[Claim 1] C: More than 0.001 mass% and below 0.007 mass % More than Si:0.05 mass % Below 0.5 mass % Mn: More than 0.5 mass% Below 2.0 mass % nickel: Less than [ 0.8 mass% ] and more than Ti:0.01 mass % Below 0.2 mass % and more than Nb:0.001 mass% Below 0.1 mass % and more than B:0.0002 mass % Less than [ 0.005 mass% ], less than [ Cu:1.0 mass% ], and more than P:0.03 mass % Below [ below 0.12 mass %, / less than / sol aluminum:0.1 mass% / and below S:0.02 mass % ] And the remainder is made from the steel slab which becomes the presentation of Fe and an unescapable impurity including less than [ N:0.005 mass% ]. Ar3 Point (degree C) It is Ar3 above. Point (degree C) After ending hot rolling in the rolling finishing temperature range below +100 **, it rolls round in a coil in the temperature region below 650 **. Or after [ BURASHINGU ] acid washing is carried out. acid washing after cold-rolling after descaling and performing primary continuous annealing at the temperature more than 750 ** -- temperature T (degree C) above 500 ** And the following formula which expresses the value of the content of Above P as (%P) (1) Or (2) The manufacture approach of a high intensity alloying hot-dip zinc-coated carbon steel sheet of excelling in the fabricating-proof brittleness characterized by performing hot dip zincing following secondary annealing in the temperature region to fill, and performing alloying processing.

[Account]
T (degree C) <=700(degree-C) -[(%P) -0.03] x1000 (degree C) --- (1) T (degree C) >=700(degree-C) +[(%P) -0.03] x1000 (degree C) --- (2)

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention proposes the approach of being high intensity and manufacturing the high intensity alloying hot-dip zinc-coated carbon steel sheet which gives suitable hot dip zincing for the high intensity cold rolled sheet steel which is excellent in press-forming nature and surface treatment nature, and is excellent in fabricating-proof brittleness. After the high intensity alloying hot-dip-zincing surface treated steel sheet concerning this invention carries out press working of sheet metal, it is used for automobile car bodies, and since the moldability and reinforcement which are required especially of them can be given to coincidence, thinning ****** of a steel plate has the effectiveness that lightweight-ization of those products can be attained.
[0002]
[Description of the Prior Art] Dissolution C and Dissolution N in steel by making carbon nitride formation components, such as Ti and Nb, contain by fully performing decarbonization processing in a steel-manufacture phase, and conventionally, considering as super-low carbon It is made to deposit as these carbon nitride, and steel which fixed C and N is used as base steel, Si, P, Mn, etc. are made to dissolve to this, and many proposals are already made about the cold rolled high tensile strength steel sheets which raised reinforcement. For example, the cold rolled sheet steel which made the above-mentioned super-low carbon Ti addition steel add a lot of Mn and P in JP,63-190141,B is indicated. In this case, by adding Mn of optimum dose, and P, the little dissolution C remains after annealing, and this raises an average of r values remarkably, and supposes that fabricating brittleness will moreover be effectively prevented for the dissolution C which exists in a grain boundary.
[0003] In addition, some examples of an indication are in the above-mentioned super-low carbon steel about the cold-rolled plate which carries out compound addition of Si, Mn, and the solid-solution-strengthening component of P. However, it was very difficult to know that these components will affect plating nature and to carry out hot dip zincing of the steel plate containing especially these components.
[0004]
[Problem(s) to be Solved by the Invention] not to mention the artificers from the above thing -- this industry -- even if it is -- a hot-dip-zincing property -- excelling -- tensile strength -- 38kgf/mm2 the above -- an average of r values -- 1.5 Moreover, the manufacture approach by which a target property is acquired by the usual continuous annealing is searched for by

alloy addition of low cost in obtaining the above hot-dip zinc-coated carbon steel sheet and this.
[0005] Therefore, the place made into the purpose of this invention The above mentioned trouble is solved advantageously, super-low carbon Ti and Nb and B compound addition steel are used as base steel, and tensile strength is 2 38 kgf(s)/mm. Above It excels in fabricating-proof brittleness and a hot-dip-zincing property, and an average r value is 1.5. It is in proposing the manufacture approach of the high intensity alloying hot-dip zinc-coated carbon steel sheet of the Takahira ** r value which becomes the above.
[0006]
[Means for Solving the Problem] Artificers have advanced research wholeheartedly paying attention to the above-mentioned super-low carbon Ti and Nb and B compound addition steel for this purpose achievement. Consequently, although it ********(ed) that an average of r high values were acquired by maintaining at super-low carbon Ti and Nb and B compound addition steel at Si, and making suitable balance maintain the content of Mn at P content so much It is NOF as a means for Si and Mn to condense on a front face in such a steel plate, and for there to be a problem of becoming easy to produce un-plating, at the time of hot dip zincing, and to conquer this. Processing (clean heating furnace) and after [ BURASHINGU ] acid-washing processing were able to be considered.
[0007] And in annealing, BURASHINGU acid washing, and a plating process, as a result of repeating research further, if primary annealing [ secondary ] is performed and secondary annealing temperature in front of plating is not optimized, the knowledge of fabricating-proof brittleness getting worse very much will be carried out newly, and this invention will be attained. In addition, the detailed reason is unknown although this is considered to be the causes with the main segregation by P. That is, the summary of this invention is as follows. C: More than 0.001 mass% and below 0.007 mass % More than Si:0.05 mass % Below 0.5 mass % Mn: More than 0.5 mass% Below 2.0 mass % nickel: Less than [ 0.8 mass% ] and more than Ti:0.01 mass % Below 0.2 mass % and more than Nb:0.001 mass% Less than [ 0.1 mass% ] and more than B:0.0002 mass % Less than [ 0.005 mass% ], Cu: Less than [ 1.0 mass% ] and more than P:0.03 mass % Below 0.12 mass %, less than [ solAl:0.1 mass% ], S: Below 0.02 mass % And the remainder is made from the steel slab which becomes the presentation of Fe and an unescapable impurity including less than [ N:0.005 mass% ]. Ar3 Point It is Ar3 more than (degree C). Point (degree C) After ending hot rolling in the rolling finishing temperature range below +100 **, it rolls round in a coil in the temperature region below 650 **. Or after [ BURASHINGU ] acid washing is carried out. acid washing after cold-rolling after descaling and performing primary continuous annealing at the temperature more than 750 ** -- temperature T (degree C) above 500 ** And the following formula which expresses the value of the content of Above P as (%P) (1) Or (2) It is the manufacture approach of a high intensity alloying hot-dip zinc-coated carbon steel sheet of excelling in the fabricating-proof brittleness characterized by performing hot dip zincing following secondary annealing in the temperature region to fill, and performing alloying processing.
[Account]
T (degree C) <=700(degree-C) -[(%P) -0.03] x1000 (degree C) --- (1) T (degree C) >=700(degree-C) +[(%P) -0.03] x1000 (degree C) --- (2) [0008]
[Function] The reason which limits a component presentation and manufacture conditions of steel in this invention is explained.
[0009] C:0.001 - 0.007 mass%, C degrades an average of r values greatly, when Dissolution C remains so much at the time of recrystallization. Moreover, although the thing low as much as possible of C content is desirable in order to also make Ti to which Dissolution C is made to fix, and Nb contain according to the amount of C, a permissible upper limit is made into 0.007mass(es) %. On the other hand, although the minimum of C content is so good that it is low, it may be 0.001 mass% from a current steel-manufacture technique.
[0010] Si: 0.05 - 0.5 mass%, its solid-solution-strengthening ability is large, and in order that

Si may not degrade an average of r values so much, it is the optimal as a solid-solution-strengthening component. It is necessary to make more than 0.05mass% for that contain. However, since surface treatment nature will worsen if a content increases, the upper limit is made into 0.5mass(es)%.
[0011] Mn: 0.5 - 2.0 mass%, since Mn is a component which lowers the transformation point unlike Si and P, it can make particle size of a hot-rolling plate very fine by utilizing this effectively. Grain refining of a hot-rolling plate is an annealing plate (111) from the grain boundary of a hot-rolling plate. Texture progresses and it is very effective in improvement in an average of r values. As for the effectiveness, a content is obtained more than at 0.5 mass%. making it contain so much on the other hand, since Mn itself is the component which degrades an average of r values -- not effective -- the content -- 2mass(es)% -- exceeding -- coming out -- plating nature's falling and a low-temperature transformation phase become easy to appear, it is no longer a ferrite and an average of r values are degraded greatly. Therefore, the content is made into more than 0.5 mass% and below 2.0mass %. Moreover, about balance with the content of Above Si, nickel which carries out the following, and Cu and P, it is desirable to be referred to as 0.2 <=(Si (mass%)+P (mass%))/(Mn (mass%)+Cu (mass%)+nickel (mass %)) <=1.0. For this, the above-mentioned balance is 0.2. If it becomes small, an average of r values will deteriorate, and it is 1.0 on the contrary. It is because the transformation point becomes high and grain refining of a hot-rolling plate cannot be desired, if it increases.
[0012] nickel: Make less than [ 0.8 mass% ] and nickel contain mainly with Cu addition. If Cu is made to contain, a low melting point phase will be made at the time of hot-rolling, and this will serve as ****** to sesame. nickel addition which makes Cu and a complete solid solution is effective in avoiding this. And since nickel is a component which lowers the transformation point like Cu and Mn, it can expect the same effectiveness as these components. However, if a content exceeds 0.8 mass%, a low-temperature transformation phase will become easy to appear, a ferrite will die, and an average of r values will be degraded greatly. Therefore, the upper limit of the content is made into 0.8 mass%.
[0013] Ti: 0.01 - 0.2 mass% and Ti are TiC, TiN, and TiS about Dissolution C, N, and S. It carries out, and since it fixes, it is made to contain. the effectiveness -- a content -- under 0.01 mass % -- not enough -- 0.2 mass% -- exceeding -- coming out -- phosphide is generated and elongation and an average of r values are degraded. Therefore, the content is made into more than 0.01mass% and less than [ 0.2 mass% ].
[0014] Nb: 0.001 - 0.1mass % and Nb are NbC about C like Ti. It is used for carrying out and fixing Dissolution C. Although immobilization of Dissolution C can do only Ti, by carrying out compound addition of the Nb, Dissolution C can be fixed more effectively and improvement in an average of r values can be desired. If under 0.001mass(es) % is not enough as a content and it makes it contain exceeding 0.1mass(es) %, it will hot-roll in the state of austenite un-recrystallizing, and the effectiveness is ****** about a bad influence to the moldability of an annealed material. Therefore, the content is 0.001mass(es). It carries out to below 0.1mass % above.
[0015] B is made to contain B:0.0002 - 0.005 mass% in order to prevent fabricating brittleness. If especially a super-low carbon steel plate is made to contain a solid-solution-strengthening component, since fabricating-proof brittleness deteriorates, it will make it indispensable to make B contain. A content the effectiveness Although it is discovered at more than 0.0002 mass%, if it is made to contain superfluously exceeding 0.005 mass%, recrystallization of an austenite will be delayed at the time of hot rolling, the load at the time of rolling will become large, and, moreover, the quality of the material of an annealing plate will be degraded. Therefore, the content is made into less than [ 0.005 mass% ] more than 0.0002 mass %.
[0016] Cu: Since less than [ 1.0 mass% ] and Cu are components which lower the transformation point like Mn and nickel, they can make particle size of a hot-rolling plate very fine by utilizing this effectively. Moreover, since Cu is a component which does not degrade

plating nature, it is very effective from the field of surface treatment nature. however, 1.0 mass% -- exceeding -- coming out -- a low-temperature transformation phase becomes easy to appear, it is no longer a ferrite and an average of r values are degraded greatly. Therefore, the upper limit of the content is made into 1.0 mass%.
[0017] P:0.03 - 0.12 mass %P are important as a solid-solution-strengthening component, solid-solution-strengthening ability is high compared with Si and Mn, and it is also the component which raises an average of r values. in order to acquire those effectiveness -- more than 0.03mass% -- although it is necessary to make it contain, if it is made to contain exceeding 0.12mass%, it will segregate to a grain boundary and the grain boundary will be embrittled. Moreover, an alloying rate is delayed to becoming the cause of the main segregation at the time of coagulation, and a pan in the case of alloying hot dip zincing. Therefore, the content is made into more than 0.03mass% and below 0.12 mass %.
[0018] sol aluminum: Although less than [ 0.1 mass% ] and aluminum are components required for deoxidation, if a sol aluminum content exceeds 0.1 mass%, inclusion will increase and the deoxidation effectiveness is not only saturated, but they will have a bad influence on a moldability. Therefore, the content is made into less than [ 0.1 mass% ].
[0019] although less than [ S:0.02mass% ] and S do not affect an average of r values -- a content -- 0.02mass(es)% -- if it exceeds -- MnS etc. -- inclusion increases and it becomes the cause of reducing the local ductility represented by elongation flange nature. Therefore, the content is made into less than [ 0.02mass% ].
[0020] N: Less than [ 0.005 mass% ] and N are TiN by Ti addition, although it is the impurity component mixed into steel unescapable. It carries out, and it fixes and a moldability is raised. However, a lot of TiN(s) If formed, degradation of workability will be imitated, and it is **. The upper limit of the permissible content is made into 0.005 mass%.
[0021] Next, the reason for limitation of manufacture conditions is explained.
Hot-rolling termination temperature: Ar3 Point -Ar3 It is necessary to change point +100 ** hot rolling termination temperature according to the transformation point. Ar3 Under in the transformation point, it will become rolling in two phase region, and ****** texture will develop a bad influence into an average of r values of an annealing plate. On the other hand, it is Ar3. If it becomes high exceeding high temperature, i.e., 100 **, to the transformation point relatively, since the particle size of a hot-rolling plate organization becomes coarse and texture effective in deep drawability stops progressing at the time of annealing, it is unsuitable. therefore, hot rolling termination temperature -- Ar3 Point (degree C) from -- Ar3 Point (degree C) It considers as the temperature requirement of +100 **.
Rolling-up temperature: When compound addition of Ti and the P is carried out like this invention, 650-degree-C or less rolling-up temperature will be limited by having found out that an average of r values deteriorated greatly, if 650 ** is exceeded. At the rolling-up temperature exceeding 650 **, this is guessed for this to have a bad influence on an average of r values of an annealed material, although the phosphide of Ti and Fe deposits so much to a hot-rolling plate and is unknown for details.
[0022] The rolling reduction is [ that what is necessary is just to perform cold rolling according to a conventional method ] also usually good in the range of common sense. Primary annealing has desirable continuous annealing. Carrying out annealing temperature in that case to more than 750 ** so that recrystallization may be completed, the upper limit is Ac1. It is desirable to make it +50 degrees C or less of points.
[0023] It is more than secondary annealing temperature T(degree-C):500 **, and the graph of the limited range of this invention is shown in T or T (degree-C) >=700 (degree C)+[(%P) -0.03] x1000 (degree-C) drawing 1 in the relation between (%P) and secondary annealing temperature. (degree C) <= 700 (degree C) -[(%P) -0.03] x1000 (degree C) Secondary annealing temperature has intense embrittlement near the 700 ** in this component system, and that temperature region is influenced by P content. Although this detailed reason is unknown, it is considered to be the cause with big the grain boundary segregation of the

phosphorus in that temperature region being promoted very much. Therefore, secondary annealing temperature T (degree C) T (degree C) <= 700 (degree C) -[(%P) -0.03] x1000 (degree C) Or T (degree C) >=700(degree-C) +[(%P) -0.03] x1000 (degree C) It carries out. Moreover, if it is not more than 500 **, it will become inadequate a steel plate front face's returning, and plating nature will worsen.

[0024]

[Example] the steel slab which becomes the chemical entity presentation shown in Table 1 -- rolling initiation temperature: -- it hot-rolled at 1250 degrees C, it rolled round in the coil, it cold-rolled with 80% of rolling reduction after acid washing, primary annealing which performs alundum bus processing for 40 seconds to the annealing temperature shown in Table 2 performed, hot dip zincing carried out following secondary annealing in the annealing temperature shown in Table 2 after acid washing, and alloying processing performed.

[0025]

[Table 1]

| 鋼No. | 化学成分 (wt%) | | | | | | | | | | | | Ar3 | 熱延温度 (℃) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | C | Si | Mn | Ni | Ti | Nb | B | Cu | P | sol.Al | S | N | (℃) | FDT | CT |
| 1 | 0.002 | 0.15 | 1.00 | 0.01 | 0.033 | 0.004 | 0.0015 | 0.01 | 0.11 | 0.054 | 0.005 | 0.002 | 837 | 870 | 600 |
| 2 | 0.003 | 0.30 | 0.80 | 0.01 | 0.035 | 0.003 | 0.0005 | 0.01 | 0.06 | 0.055 | 0.005 | 0.003 | 863 | 870 | 600 |
| 3 | 0.003 | 0.15 | 1.20 | 0.01 | 0.015 | 0.020 | 0.0015 | 0.02 | 0.06 | 0.053 | 0.005 | 0.003 | 813 | 850 | 550 |
| 4 | 0.002 | 0.40 | 0.99 | 0.01 | * 0.210 | 0.021 | 0.0012 | 0.01 | 0.05 | 0.052 | 0.005 | 0.002 | 852 | 870 | 550 |
| 5 | 0.002 | 0.20 | 1.50 | 0.01 | 0.040 | 0.006 | 0.0010 | 0.01 | 0.06 | 0.028 | 0.003 | 0.002 | 800 | 870 | 550 |
| 6 | 0.002 | 0.22 | 1.20 | 0.02 | 0.036 | 0.004 | 0.0015 | 0.01 | * 0.16 | 0.052 | 0.005 | 0.002 | 828 | 850 | 550 |
| 7 | 0.004 | 0.40 | 1.25 | 0.02 | * 0.006 | 0.005 | 0.0020 | 0.01 | 0.03 | 0.032 | 0.006 | 0.003 | 825 | 890 | 550 |
| 8 | 0.001 | 0.20 | 1.02 | 0.61 | 0.037 | 0.005 | 0.0012 | 0.01 | 0.06 | 0.024 | 0.007 | 0.003 | 800 | 850 | 550 |
| 9 | 0.002 | 0.20 | 1.02 | 0.01 | 0.012 | 0.034 | 0.0010 | 0.50 | 0.06 | 0.044 | 0.004 | 0.003 | 809 | 890 | 550 |
| 10 | 0.002 | 0.21 | 1.02 | 0.40 | 0.032 | 0.005 | 0.0012 | 0.71 | 0.06 | 0.045 | 0.003 | 0.002 | 790 | 850 | 600 |
| 11 | 0.002 | 0.19 | 1.00 | 0.01 | 0.025 | 0.003 | 0.0020 | * 1.20 | 0.06 | 0.040 | 0.004 | 0.002 | 775 | 900 | 550 |
| 12 | 0.003 | * 0.80 | 1.20 | 0.01 | 0.034 | 0.005 | 0.0020 | 0.02 | 0.06 | 0.036 | 0.004 | 0.002 | 867 | 850 | 600 |
| 13 | 0.002 | 0.15 | * 2.50 | 0.02 | 0.038 | 0.006 | 0.0018 | 0.01 | 0.06 | 0.028 | 0.003 | 0.002 | 692 | 850 | 600 |

注：＊印はこの発明の限定範囲を外れるもの

[0026]

[Table 2]

| 鋼No. | 1次焼鈍温度 (℃) | 2次焼鈍温度 (℃) | 合金化温度 (℃) | 引張強さ (kgf/mm²) | 亜鉛めっきの評価 | | | | | | 備考 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 平均r値 | めっき性 | めっき密着性 | η残存 | 脆性遷移温度 (℃) | 脆性判定 | |
| 1 | 850 | 820 | 550 | 41.5 | 1.6 | ○ | ○ | ○ | − 50 | ○ | 適合例 |
| 1 | 850 | * 700 | 555 | 41.8 | 1.8 | ○ | ○ | ○ | − 20 | × | 比較例 |
| 2 | 880 | 780 | 520 | 41.0 | 1.65 | ○ | ○ | ○ | − 70 | ○ | 適合例 |
| 3 | 870 | 640 | 530 | 40.5 | 1.58 | ○ | ○ | ○ | − 60 | ○ | 適合例 |
| * 4 | 870 | 820 | 520 | 41.3 | 1.3 | ○ | ○ | ○ | − 50 | ○ | 比較例 |
| 5 | 880 | 750 | 520 | 42.5 | 1.5 | ○ | ○ | ○ | − 55 | ○ | 適合例 |
| * 6 | 890 | * 750 | 560 | 43.2 | 1.7 | ○ | ○ | × | − 20 | × | 比較例 |
| * 7 | 880 | 720 | 520 | 40.2 | 1.32 | ○ | ○ | ○ | − 50 | ○ | 比較例 |
| 8 | 860 | 800 | 520 | 42.5 | 1.52 | ○ | ○ | ○ | − 55 | ○ | 適合例 |
| 9 | 880 | 820 | 520 | 41.3 | 1.6 | ○ | ○ | ○ | − 60 | ○ | 適合例 |
| 10 | 850 | 800 | 520 | 43.8 | 1.55 | ○ | ○ | ○ | − 65 | ○ | 適合例 |
| 10 | 870 | * 700 | 520 | 43.5 | 1.6 | ○ | ○ | ○ | − 30 | × | 比較例 |
| * 11 | 850 | 800 | 530 | 44.0 | 1.3 | × | × | ○ | − 55 | ○ | 比較例 |
| * 12 | 860 | 800 | 530 | 46.1 | 1.6 | × | × | ○ | − 50 | ○ | 比較例 |
| * 13 | 850 | 800 | 520 | 45.8 | 1.2 | × | × | ○ | − 30 | × | 比較例 |

注：＊印はこの発明の限定範囲を外れるもの

About the alloying hot-dip zinc-coated carbon steel sheet obtained in this way, tractive characteristics, secondary elaboration-proof brittleness (brittle transition temperature), etc. were investigated, and it evaluated [ galvanization ] about plating nature, plating adhesion, an alloying rate, etc. These results of an investigation were collectively shown in Table 2.
[0027] It is the JIS No. 5 test piece (parallel part width of face of 25mm, 50mm of gauge length) which the tensile test performed temper rolling of 0.8 % here, and was extracted at the rolling direction. It carried out by using. Measurement of an r value was performed by giving tensile strain 15% by 25mm of gauge length using the JIS No. 5 test piece extracted the 45 degree direction (D) of rolling direction (L) rollings, and from the rolling right angle (T). And an average of r values were calculated from average r value = (rL+rT+2rD) / 4. Fabricating-proof brittleness is a contraction ratio 1.8. Temperature into which an impact of 80cm - 5 kg is given to at predetermined temperature, and a crack begins to go was made into transition temperature after fabricating in a cup.
[0028] Moreover, evaluation and the criterion of a galvanization were performed according to the following.
- The appearance viewing judging after plating nature hot dip zincing estimated.
O Galvanize[ un-]-less x Non-galvanized generating / plating adhesion E. I. du Pont de Nemours impact test (semi-sphere diameter: 6.35 mm (1/4 inch), dead weight:1kg, and height:500mm) It evaluated.
O Plating-exfoliation-less x Whether zincky eta phase remains on those with plating exfoliation and an alloying rate alloying galvanized steel sheet front face estimated the alloying rate.
O eta-phase-less x Those with eta phase [0029] All the examples of adaptation to which this component presentation and manufacture conditions suit this invention so that clearly from Table 1 and 2 are tensile strength:40 kgf/mm2. It is average r value:1.5 above. The alloying hot-dip zinc-coated carbon steel sheet also with good evaluation of a galvanization is obtained less than [ brittle transition-temperature:-50 degree C ] above.
[0030] About steel No.1 shown in Table 1 below, secondary annealing temperature was changed and those brittle transition temperature was measured. In addition, primary annealing temperature was fixed with 850 **. Those results are summarized to drawing 2

and shown. Drawing 2 is the graph which shows the relation between secondary annealing temperature and a brittle transition temperature, and when secondary annealing temperature is in the limited range of this invention, a brittle transition temperature being -45 degrees C or more made into the criterion, and excelling in fabricating-proof brittleness is shown.
[0031]
[Effect of the Invention] By this invention limiting the component presentation of super-low carbon Ti and Nb and B compound addition steel, and pinpointing secondary annealing temperature regions in front of plating, the high intensity alloying hot-dip zinc-coated carbon steel sheet which is excellent in fabricating-proof brittleness is obtained, and the steel plate by this invention can be applied in favor of the object for automobiles, and home electronics, and can contribute to those lightweight-ization.

[Translation done.]

* NOTICES *



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## DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] In the relation between (%P) and secondary annealing temperature, it is the graph which shows the limited range of this invention.
[Drawing 2] It is the graph which shows the relation between secondary annealing temperature and a brittle transition temperature.

[Translation done.]

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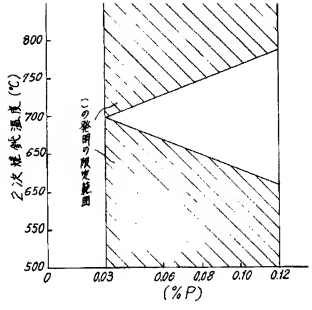
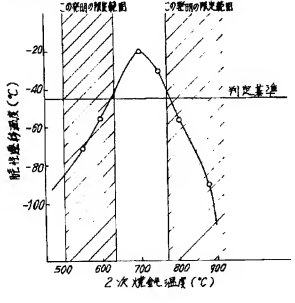
## DRAWINGS

[Drawing 1]




[Drawing 2]

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